Quasi-Amorphous Colloidal Structures for Electrically Tunable Full Color Photonic Pixels with Angle-Independency

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Electrically tunable photonic band gap (PBG) materials based on crystalline structures have been developed for active components of display. Despite considerable advances, the intrinsic drawbacks of the crystalline PBG materials such as the strong angle dependent hue and difficulty of fabricating defect-free structures in large area have yet to be addressed for their practical applications. Here we report quasi-amorphous colloidal structures exhibiting angle-independent photonic colors in response to the electric stimuli. Moderately polydisperse colloidal Fe_3O_4@SiO_2 nanoparticles dispersed in organic solvents exclusively form quasi-amorphous photonic materials at sufficiently high concentrations (> 30 wt%), and which reversibly reflect incident light in visible region (λ_{peak} = 490 ~ 655 nm) in response to the relatively low bias voltage (0 ~ 4 V). We show the angle-independent tunable photonic colors with the fast response time (50 ~ 170 ms) due to the isotropic nature of quasi-amorphous structures. Conventional vacuum injection technique is applicable for fabricating flexible full color photonic display pixels with various pre-defined shapes.